PATENT SPECIFICATION

405,817

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Complete Accepted: Feb. 15, 1934.

COMPLETE SPECIFICATION.

Gauging Apparatus for Grinding or Abrading Machines or like Machine Tools.

We, LANDIS TOOL COMPANY, a corporation of the State of Pennsylvania, United States of America, of Waynesboro, Pennsylvania, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to gauging apparatus for grinding or abrading machines or like machine tools.

An object of the invention is to provide means responsive to very small reduction in the size of the work for controlling the grinding of the work.

A further object is to provide a gauge device using a jet of fluid, the pressure of which varies with the dimensions of the work piece and in which variation in pressure is indicated in suitable manner or is caused to control certain mechanism on the machine with which the gauge is used.

A still further object is to provide means whereby variation in the pressure of the said jet will cause various parts of a machine to function at predetermined points in a grinding operation.

With these objects in view the present invention consists in gauging apparatus for grinding or abrading machines or like machine tools, wherein a jet of fluid escaping from a constant pressure source is directed against an element maintained in contact with the surface being machined, whereby escape of fluid is reduced during machining so as to build up pressure behind the jet, which pressure is utilised to operate pressure responsive means.

Reference will now be made to the accompanying drawings which illustrate the invention as applied to a grinding machine, and on which similar reference characters indicate similar parts,

Figure 1 is an end elevation of a work piece and that part of the device which engages the work piece,

Figure 2 is a more detailed view on an enlarged scale of the work engaging elements of the device,

Figure 3, a sectional view taken on the line 3—3 Figure 2, of the air nozzle and the connections to the air gauge,

Figure 4, a front elevation of a portion of the piping arrangement showing the pressure gauge in section, together with electrical connections, and

Figure 5, a diagrammatic view of the electrical circuits which are controlled by the gauge.

In carrying out the invention gauging means are provided on a grinding machine for directing a jet of air or other fluid against a pad or other obstruction in such a manner that as the work is decreased in size the restriction between the jet and the pad will be decreased in size to limit the freedom with which the fluid may issue out through the restriction. A restricting of the fluid in turn will build up a pressure in advance of the jet and means are provided for causing this increasing pressure to operate suitable mechanism on the machine with which the device is associated all as will be more fully described hereinafter.

In the drawings numeral 10 indicates a block in which are mounted two adjustable work engaging elements consisting of a screw 12 and a bent finger 13. The screw and the finger have work engaging contacts 14 and 15. The screw 12 is longitudinally adjustable in the upper end of the block and is secured in adjusted position by means of a clamping plate held by a screw 16. The block is also provided with a threaded aperture 17 for receiving the screw 12, this aperture being positioned at an angle to the position in which it is shown in Figure 2 for use in gauging work of a smaller diameter, such as shown in dotted line position A in Figure 1. The finger 13 is provided with pins 18, 21 and 22 which rest in sockets in the lower end of the block, the pins serving to prevent rotation of the finger in the block. The finger is held upon the block by means of a plate 19 secured by screws 20. When gauging work of relatively large diameter the finger will be in the position shown in Figure 2; the finger, however, may be moved so that the two pins 18 and 21 will be held in the plate instead of pins 21 and 22 as shown

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in Figure 2. A spring 23 is secured to the block by means of a screw 24 and this spring carries on its free end a contact element 25 adapted to engage the surface of the work 11. Directly under the rear flat side 26 of the contact element is a nozzle 27 which is tightly secured in the block 10. A hole in this nozzle registers with a bore 28 in the block. The block 10 is supported on a plug 29 and is secured to the plug by means of a plate 30 and a screw 31. The plug is provided with an axial bore 32 which bore terminates in a radial bore 33 which registers with the bore 28 in the block 10. An annular groove 34 is provided in the plug to permit passage of fluid from the bore 32 into the bore 28 irrespective of the circumferential position of the block on the plug. A hose 35 is attached to the end of the plug for supplying fluid under pressure to the bore 32. The plug is carried on the lower end of an arm 36 and is freely rotatable in the arm to permit the contacts 14 and 15 both to come into contact with the periphery of the work.

The upper end of the arm 36 is pivotally attached to a base 38 by means of a stud 37 which passes through a slot in the base. The arm may be adjusted toward and from the work and secured in adjusted position by stud 37. The upper side of the arm 36 carries a lug 39 to which is connected a spring 40, the other end of the spring being connected to a lug 41 on the base 38. The purpose of the spring is to hold the work engaging parts in contact with the work piece. A stop screw 42 is threaded through the lug 41 and locked in adjustable position by a nut 43. The stop screw limits the movement of the arm 36 beyond a predetermined position when there is no workpiece in the machine and consequently nothing to stop movement of the arm. A plate 44 is pivotally and adjustably secured to the arm 36. This plate carries a finger 45 which projects into a notch 46 in the block 10 and limits the oscillation of the block beyond predetermined limits. The base 38 is secured to the work table of the machine by a clamping bolt 47.

From the description so far given it will be apparent that as the work is reduced in size the restriction between the nozzle 27 and the under face 26 of the contact element 25 will be reduced in size. This decreases the jet of fluid issuing from the bore 28 and consequently tends to build up pressure in the line 35.

Suitable means for utilizing this increasing pressure will now be described. The pipe 48 represents a high pressure fluid line. The fluid may be air or any other suitable fluid under pressure. Under some circumstances water may be found feasible. Pressure reducing valves 49 and 50 of suitable construction may be provided between the high pressure line 48 and a line 51. This provides fluid under relatively low pressure in the line 51 and at the same time insures that the pressure in the line 51 will be practically constant. Any suitable pressure fluid line having fluid under proper and constant pressure may be substituted for line 51, in which case reducing valves 49 and 50 may be dispensed with.

The line 51 is connected to a block 52. This block is bored at 53 and 54. The hose or pipe 35 is connected to the block in register with the bore 54 and a pipe 55 is connected to register with the bore 53. Fluid from the line 51 passes through a restricted passage 56 provided in a plug 57 positioned with its discharging end adjacent the inter-section of the bores 53 and 54. A manometer tube 58 is partially filled with some suitable electrical conducting liquid 59. This may be mercury or any other suitable liquid. The tube 58 is preferably U-shaped and one end of the U is continued in the form of an inverted U, one leg of which last named U is connected to the pipe or tube 55 by means of a sleeve or a connecting tube 60. In order to limit fluctuation of the liquid in the U-tube a restriction 61 may be provided in one leg of the tube. Contact elements 62 and 63 are positioned in the open end of one leg of the U and are mounted on a block 64 carried by a depending tube 65 which is secured on a support 66. The support 66 is mounted upon a block 67 and is adjustable vertically of the block by means of a screw 68. Rotation of the screw 68 as will be seen provides for vertical adjustment of the contacts 62 and 63 toward and from the surface of the mercury or other liquid in the manometer tube. A third contact 69 is positioned intermediate contacts 62 and 63 and is carried on a rod 70 which is secured to a support 71. This support in turn is mounted upon the arm 66 and is adjustable vertically on this arm by means of a screw 72. Rotation of the screw 72 serves to adjust the contact 69 with relation to the contact 63. Block 67 is secured in fixed position on some stationary portion of the machine. Contacts 62, 63 and 69 are respectively connected to wires 73, 74, 75. A diagrammatic showing of the circuits controlled by contacts 62, 63 and 69 is given in Figure 5. Current from a suitable outside source is supplied through wires 76 and 77. This is high potential current which may be direct or alternating current. For the purpose of convenience in

the present case lines 76 and 77 may be direct current through lines connected to the grinding wheel drive motor. This circuit generally carries current at high potential which must be reduced either by a transformer or a resistance. Such resistance bank is shown as a whole at 78. The line current makes a complete circuit from line 77 through resistors 79, 80, 81 and 82 connected in series and so arranged that from the point 83 to point 84 there is a total voltage drop equivalent to the line voltage. The mercury switch contacts 62, 63 and 69 are preferably very low voltage, usually about ten volts. The resistors 79 and 80 are such as to provide the necessary voltage drop. For the purpose of better understanding the device all line voltage circuits are shown in heavy black lines while the ten volt or pilot circuits are shown in lighter lines.

From resistor 81 there is a ten volt circuit which operates a relay 85 as follows: Resistor 81 is connected through line wire 86 and 73 with contact 62, then through the mercury 59 to contact 69, thence through wires 75 and 87 with the coil 85 and from the other terminal of this coil circuit is completed through line 88 back to the resistor 81. Thus when mercury closes contacts 62 and 69 the magnetic switch or solenoid 85 is energized. This closes switch 89 and closes contact through line 90 with line 76 and through line 91 and line 92 closes contact with line 77 to energize solenoid 93. The solenoid 93 may cause operation of any suitable mechanism or group of mechanisms on the machine with which the device is associated, for example, it may slow down rotation of the work or stop wheel feed toward the work when the work has been ground approximately to its finished size. A condenser 94 is connected through resistor 95 directly across the mercury contacts 62 and 69 to prevent sparking or arcing when the circuit is made or broken by the mercury. This, coupled with the fact that the relay 85 is delicate requiring only a very small current to operate, reduces the burning and pitting of the contacts 62 and 69 to a minimum. When circuit is closed by the mercury between contacts 63 and 69 relay coil 96 is energized to close the switch 97. This closes circuit through line 98 with the lead-in line 76 and other lines 99 and 100 close circuit with the line 92 to lead-in line 77 to energize solenoids 101 and 102. The solenoids 101 and 102 may respectively control mechanism for stopping operation of the machine and restoring parts to position for beginning a new operation after the work has been ground to finished size.

By means of the adjusting screw 72 the distance between contacts 69 and 63 may be controlled so as to control the amount of stock left for a finishing grinding operation.

A condenser 103 is connected through wires 104, 74, and resistance 95, wires 86 and 73 with the contacts 63 and 62 to reduce or prevent sparking and consequent pitting of the contact elements.

The operation of the device as a whole is as follows:

Arm 36 is positioned so that the spring 40 will bring contacts 14 and 15 into engagement with the periphery of the work. Screw 12 and arm 13 will be adjusted longitudinally so that when the contacts 14 and 15 are in engagement with the work there will be a slight clearance between the surface 26 of the contact 25 and the end of the nozzle 27. Fluid under a predetermined pressure will be maintained in the line 51. This pressure will be kept as near constant as is possible by means of pressure reduction valves 49 and 50. Pressure fluid will flow through line 35 and bore 32 out through the nozzle 27. Fluid passing from the line 51 into line 35 will issue through a restriction at 56 which will increase its velocity at the mouth of the tube 57. Due to the venturi effect the velocity of the fluid at this point will create reduction of pressure in the bore 53. When the fluid is flowing freely through the orifice between the nozzle 27 and the surface 26, a decided reduction in pressure will be created on the surface of the liquid in the right leg of the U-tube or manometer. As the restriction adjacent the surface 26 becomes small, fluid will issue more slowly from the line 35. This will tend to decrease the aspirating effect of the jet at the mouth of the bore 53, and thus tend gradually to increase the pressure through this bore to the surface of the liquid in the manometer. The increased pressure in the bore 53, however, will be very little and will build up very gradually until the nozzle 27 has been brought into very close proximity to the surface 26. When the restriction has been cut down to a minimum at 26, pressure in the line 35 will approach the pressure in the line 51. This will reduce the velocity of the fluid flowing through restriction 56 and this reduced velocity will upset the aspirating action and create a pressure in the bore 53 approximating the pressure in the line 35. The increase in pressure through the bore 53 will be rather sudden so that pressure on the liquid column in the manometer will be changed very suddenly from a negative or low pressure to a decidedly high positive pressure. This will move

the column of liquid upward in the left leg of the U-tube closing electrical contact between contact elements 62 and 69. For every position of the contact element 25 there is a definite aperture which causes a definite flow of fluid and for every definite flow of fluid there is a definite pressure which causes the mercury to rise to a definite point on the manometer tube. When these contacts 62 and 69 are closed through the circuits heretofore described, solenoid 85 will be energized, switch 89 closed and solenoid 93 energized to effect operation of certain mechanism with which the device is connected, such as a slowing down of the wheel feed or slowing down rotation of the work, etc. The device will be so adjusted that when the work reaches finished size the restriction at the nozzle will be exceedingly fine. The pressure in bore 53 will then cause the mercury to close contact between 69 and 63. When contacts 63 and 69 are closed by the mercury body, solenoid 96 will be energized to close switch 97 and energizes solenoids 101 and 102 to stop operation of the machine and to cause any other operations found necessary after the work has been ground to this finished size.

One result brought out by this construction is that for a very small variation in the size of the work piece there is a comparatively great increase in the pressure in the manometer tube. Movement of the column of liquid in the manometer tube is many times greater than the reduction in the size of the work. This provides a precision instrument that is exceedingly sensitive to very small changes in the size of the work and provides a control device so sensitive as to insure grinding or machining the work to a predetermined standard within limits heretofore practically impossible. If desired suitable graduations may be made on the manometer tube to indicate movement of the column of liquid on the tube and thus indicate the size of the work as it approaches finished size.

It will be obvious to those skilled in the art that various changes may be made in our device without departing from the spirit of the invention and therefore we do not limit ourselves to what is shown in the drawings and described in the specification, but only as indicated by the appended claims.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Gauging apparatus for grinding or abrading machines or like machine tools, wherein a jet of fluid escaping from a constant pressure source is directed against an element maintained in contact with the surface being machined, whereby escape of fluid is reduced during machining so as to build up pressure behind the jet, which pressure is utilised to operate pressure responsive means.

2. Gauging apparatus as claimed in claim 1, wherein said pressure responsive means comprises a manometer tube containing an electrically conducting liquid and provided with electrical contacts which are closed by the liquid when it reaches a predetermined level to complete a circuit to operate means to slow down or stop the feed of the tool or slow down rotation of the work piece.

3. Gauging apparatus as claimed in claim 2, wherein further rise in the height of the liquid completes another circuit to operate means for stopping the machine.

4. Gauging apparatus as claimed in any one or more of the preceding claims as applied to a machine for grinding or abrading a cylindrical work piece, wherein the jet and said element are mounted on a support having spring means to urge it towards the work piece and a pair of contacts are provided fixed to the support and arranged to engage with the work piece at spaced points on either side of said element.

5. Gauging apparatus as claimed in claim 4, wherein said support is pivotally mounted on an arm which in turn is pivotally carried on a fixed support, the arm being biassed by spring means to maintain said element and said contacts in engagement with the work.

6. Gauging apparatus as claimed in claim 2 or 3, wherein the circuit or each circuit is supplied with current from a line supply circuit at a fraction of the voltage thereof and includes a relay coil which when energised closes a switch included in a circuit connected with the line supply and which operates a solenoid

7. Gauging apparatus substantially a described with reference to the accompanying drawings.

Dated this 6th day of March, 1933.

MARKS & CLERK.

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Fig 1

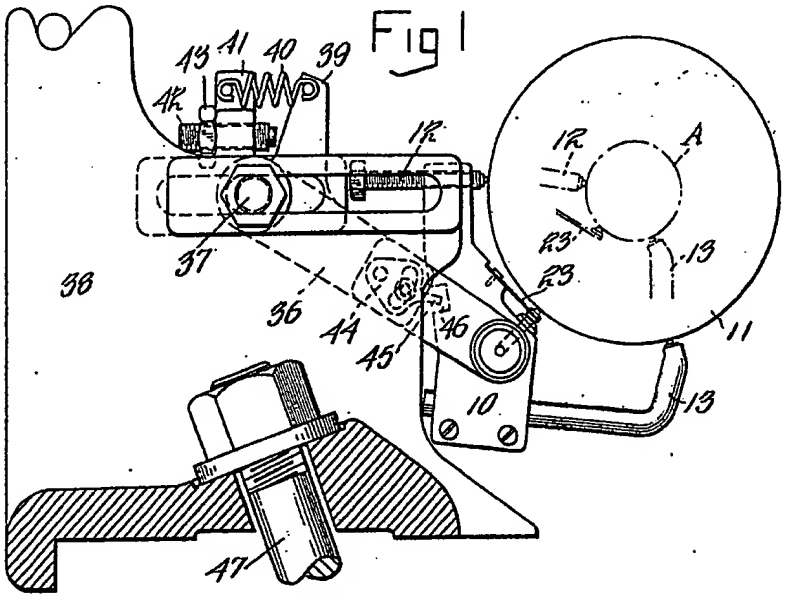


Fig 3

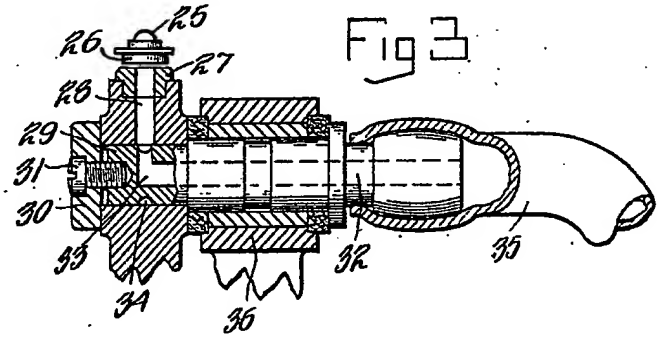
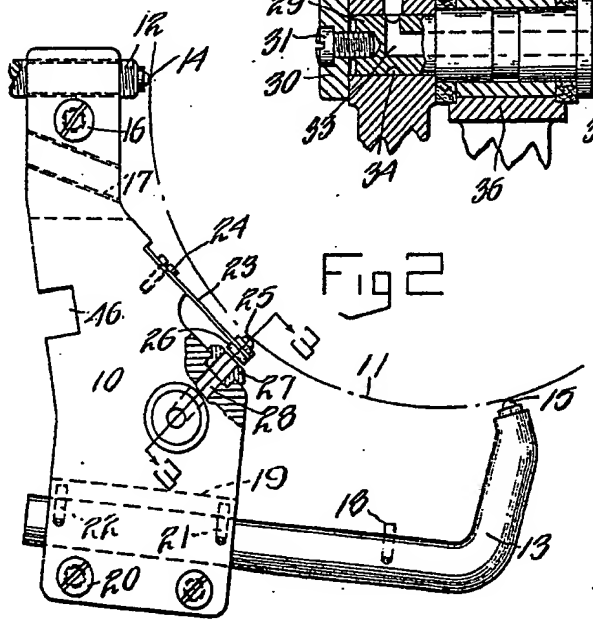
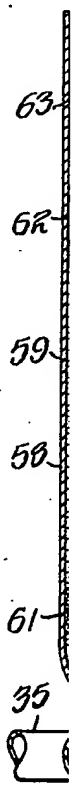


Fig 2





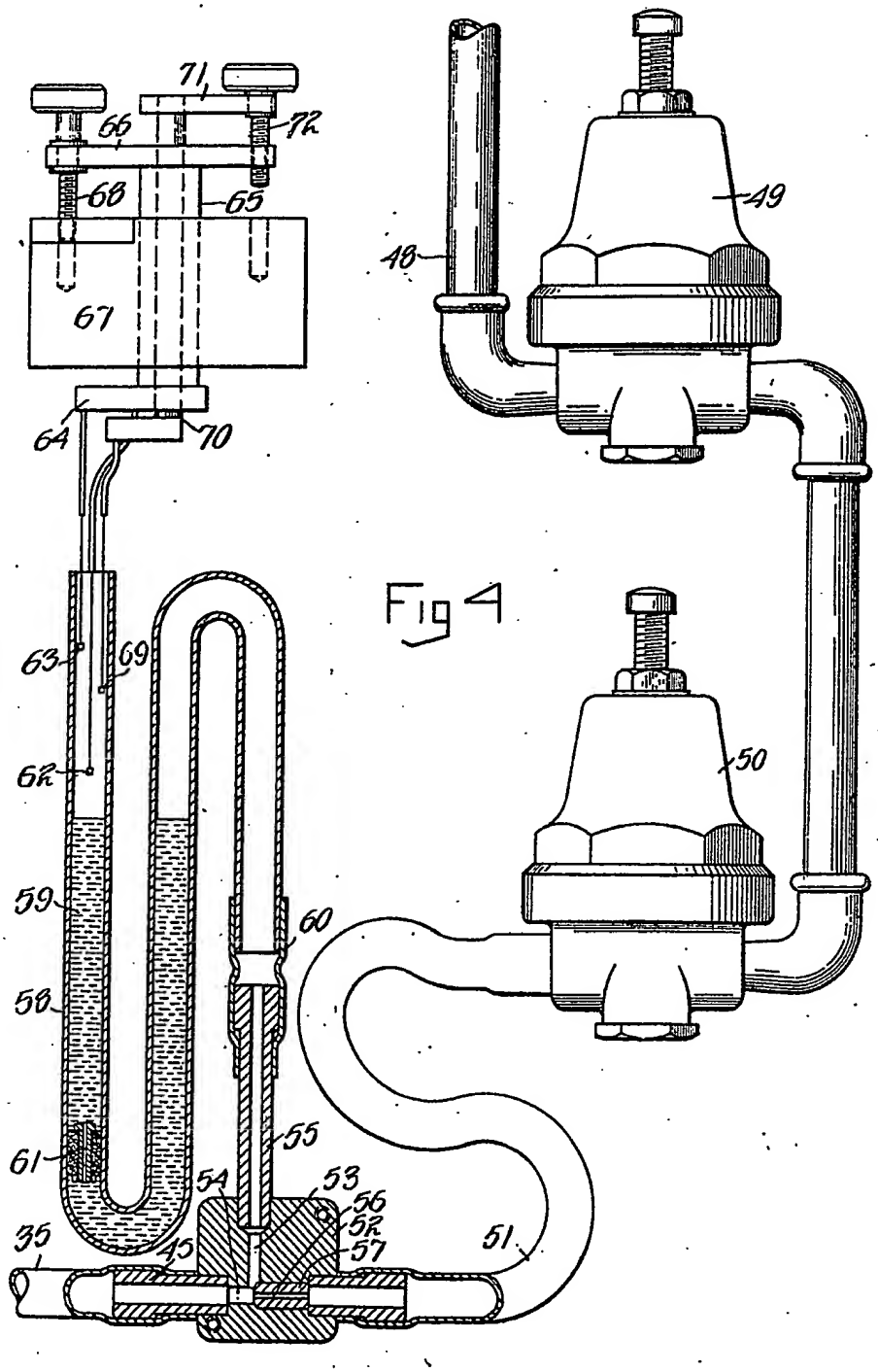


Fig 4

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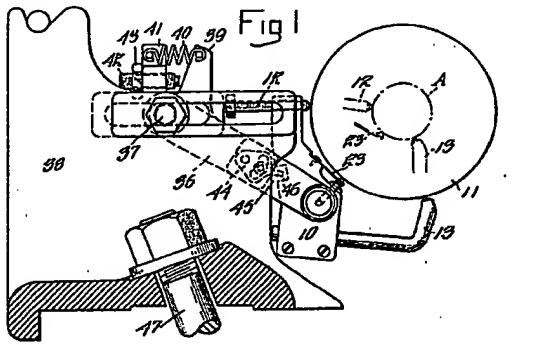
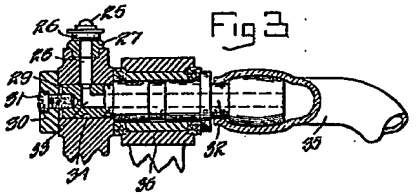
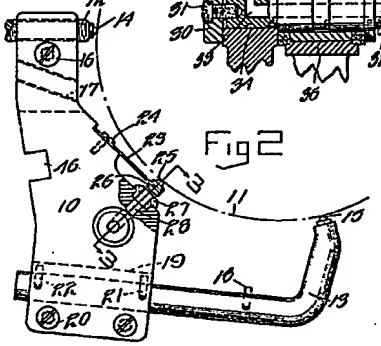
405,817 COMPLETE SPECIFICATION

3 SHEETS

SHEET 1







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SHEET 2

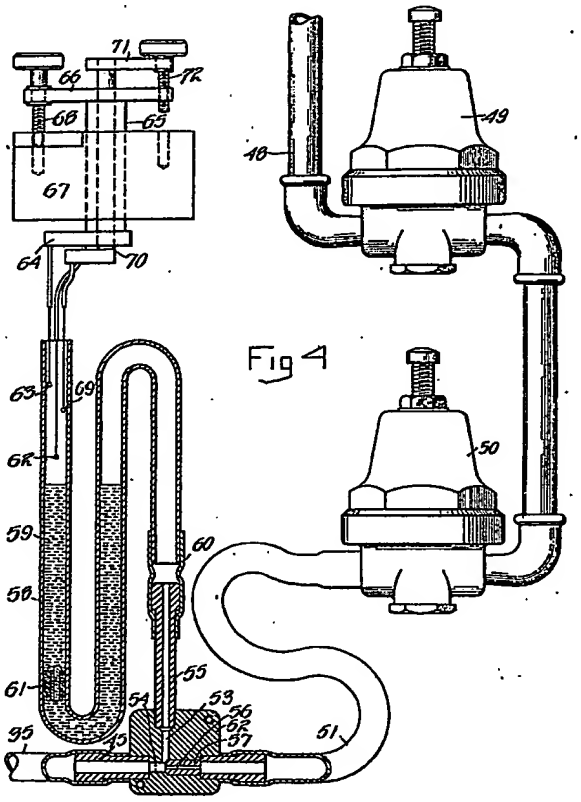

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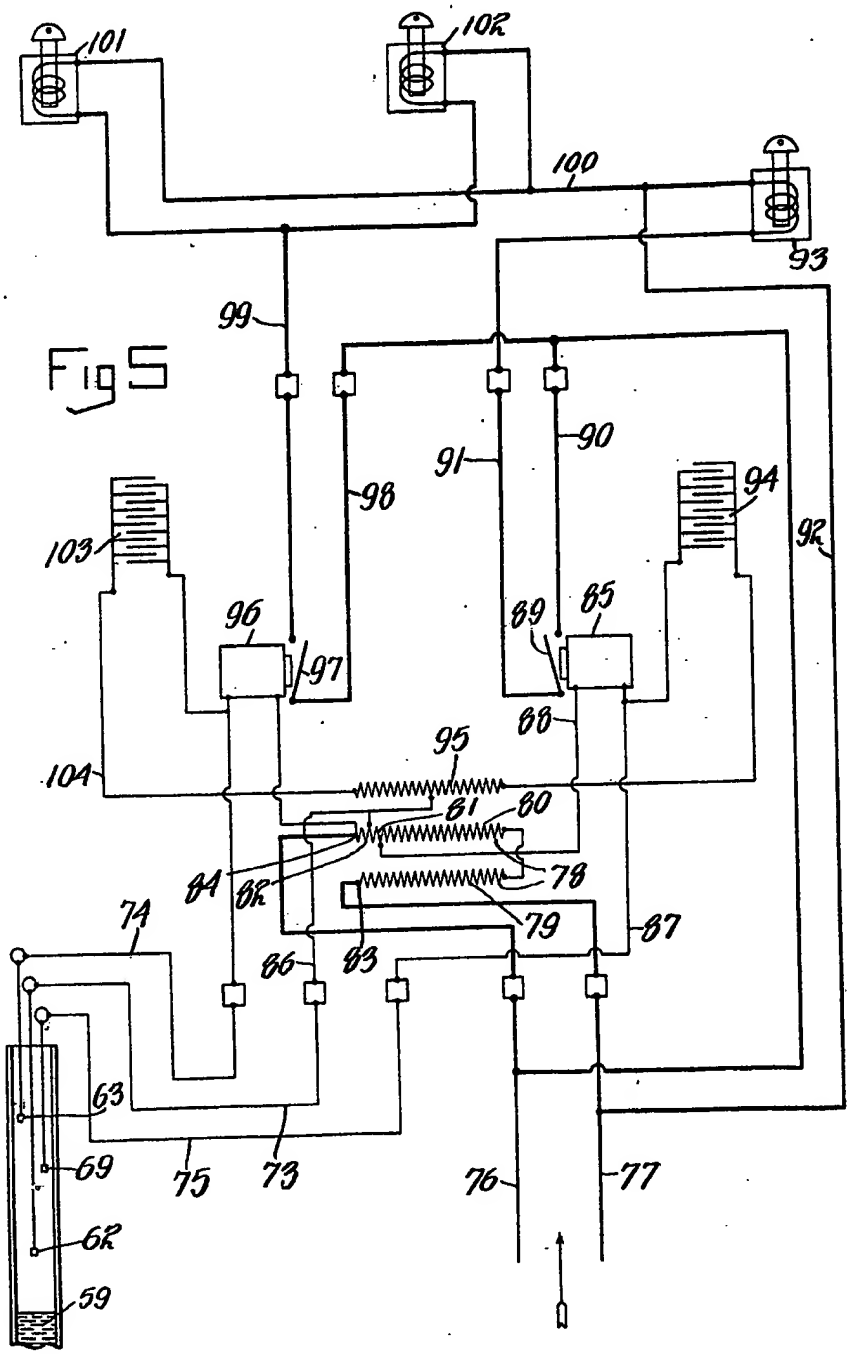
Fig 5



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